



Research Note

Lives Saved Calculations for Infants and Toddlers

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Summary

The effectiveness of a vehicle restraint system (e.g. child safety seat, lap and/or shoulder belts) measures the protection provided by that restraint use in preventing a traffic fatality. The National Highway Traffic Safety Administration (NHTSA) has calculated estimates for the effectiveness of various restraint systems through analyses of data from the Fatality Analysis Reporting System (FARS). These effectiveness estimates are used in this report to calculate the number of infant and toddler lives saved in 2003 through the use of child safety seats and lap and/or shoulder belts.

Table 1 contains child safety seat effectiveness estimates. The rate of effectiveness for infants in child safety seats in passenger cars means that 71 percent of infants in passenger cars who would die without a child safety seat would survive the crash if they were restrained in a child safety seat. Table 2 contains lap and/or shoulder belt effectiveness estimates.

A summary of estimates for the effectiveness of child restraints was published in the research note *Revised Estimates of Child Restraint Effectiveness* (Hertz, 1996). The estimates are stratified by vehicle type (passenger cars, or light trucks and vans) and the age of the child (infant: less than one year old; toddler: 1 – 4 years old).

Beginning with FARS 2003 data, an effectiveness of zero percent has been applied to infants in lap and/or shoulder belts. This zero percent effectiveness means that an infant placed in a lap and/or shoulder belt is no more or less

likely to survive a crash than an infant who is unrestrained.

Table 1
Estimated Fatality Reducing Effectiveness
of Child Safety Seats

Vehicle Type	Age Group	
	Infants (0 years old)	Toddlers (1-4 years)
Passenger Cars	71 %	54 %
Light Trucks and Vans	58 %	59 %

Source: NCSA, NHTSA

Table 2
Estimated Fatality Reducing Effectiveness
of Lap and/or Shoulder Belts

Vehicle Type	Age Group	
	Infants (0 years old)	Toddlers (1-4 years)
Passenger Cars	0 %	47 %
Light Trucks and Vans	0 %	48 %

Source: NCSA, NHTSA

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Methodology

In order to calculate the number of lives saved by child safety seats and lap and/or shoulder belts, the following variable definitions and formulas will be used.

F = number of fatalities, by restraint type, age category and vehicle type

E = estimated effectiveness, by restraint type, age category and vehicle type

Stratified by restraint use, age category and vehicle type, the number of potential fatalities is estimated to be

$$\text{Potential fatalities} = \frac{F}{1 - E}$$

and the number of lives that were saved is estimated to be

$$\text{Lives saved} = E * \frac{F}{1 - E}$$

The number of *potential lives saved* is based on the assumption that child safety seats are the most effective child restraint for infants and toddlers. For infants and toddlers in child safety seats, the number of lives saved is equal to the number of potential lives saved, given that child safety seats are the most effective restraint type for infants and toddlers.

Children under five years old whose restraint use was coded as “Child Safety Seat” or “Child Safety Seat Used Improperly” were considered restrained in a child safety seat. Children whose restraint use was “Shoulder Belt”, “Lap Belt”, “Lap and Shoulder Belt”, or “Safety Belt Used Improperly” were grouped into the “Lap and/or Shoulder Belt” restraint use category. Those children with a restraint use variable coded as “None Used / Not Applicable” were considered unrestrained. Children whose restraint use was coded as “Unknown” were pro-rated between the restrained and unrestrained categories.

Children whose restraint use was coded as “Restraint Used, Type Unknown” were pro-rated between the two restraint categories, child safety seat and lap and/or shoulder belt. The

pro-rated fatality counts in the table below have been rounded off to the nearest integer.

In addition to restraint use, age category, and vehicle type, other variables were examined yet were not included in the effectiveness estimates listed below due to a lack of heterogeneity among their differing categories.

Changes

The increasing popularity of light trucks and vans (LTV) led Hertz (1996) to calculate separate child safety seat and lap and/or shoulder belt effectiveness numbers for passenger cars and LTVs. Hertz’s effectiveness numbers were first implemented with 2002 FARS data to calculate the number of lives saved among infants and toddlers. These updated effectiveness numbers were calculated using the same paired comparison methodology reported in *Lives Saved by Child Restraints from 1982 through 1987* (Partyka, 1988).

Partyka, using FARS data from 1982 through 1987, estimated child safety seats to be 69 percent effective against fatalities for infants and 47 percent effective for toddlers; adult seat belts were estimated to be 36 percent effective for children up through 4 years old. Given the 1980’s proliferation of passenger cars, Partyka’s estimates were created to apply only to passenger cars and did not include light trucks and vans.

In addition to incorporating Hertz’s updated effectiveness estimates, the infant and toddler lives saved calculations made with 2002 and/or 2003 FARS data include a change in the definition of child safety seats. The restraint use categories “Child Safety Seat” and “Child Safety Seat Used Improperly” are combined, to reflect the methodology that Hertz used to calculate the effectiveness estimates. Before this change, a child whose restraint use was “Child Safety Seat Used Improperly” was considered unrestrained.

In 2002, the National Occupant Protection Use Survey (NOPUS) estimated that 98 percent of infants traveled in child safety seats. In 2003, FARS data showed that zero infants were fatally injured in lap and/or shoulder belts. Given the limited use of lap and/or shoulder belts by

infants, NHTSA has determined there to be insufficient data to estimate an effectiveness for lap and/or shoulder belts for children under one year old. Therefore, the effectiveness for lap and/or shoulder belts was updated in 2003 to be 0 percent for infants. This effectiveness figure states that infants are neither more safe nor less safe travelling in lap and/or shoulder belts, compared to travelling unrestrained.

Results

Lives saved estimates using the new methodology are illustrated below in Table 3 using 2003 FARS fatality counts. Table 4, also using 2003 FARS fatality counts, is an example of the lives saved methodology which was used prior to the changes implemented in 2002 and 2003.

Separate lives saved calculations are shown for each combination of vehicle type, child's age, and restraint use type.

Table 3 New Methodology: Estimated Lives Saved Among Infants and Toddlers Through Child Safety Seat (CSS) or Lap and/or Shoulder Belt (L/S) Usage, FARS 2003							
Vehicle Type	Child's Age	Restraint Type	Effectiveness	Fatalities	Potential Fatalities	Lives Saved	Potential Lives Saved
Passenger Cars	Infant	CSS	71 %	66	228	162	162
Passenger Cars	Infant	L/S	0 %	0	0	0	0
Passenger Cars	Infant	None	0 %	19	19	0	13
Passenger Cars	Toddler	CSS	54 %	126	273	147	147
Passenger Cars	Toddler	L/S	47 %	35	65	31	35
Passenger Cars	Toddler	None	0 %	73	73	0	39
Light Trucks and Vans	Infant	CSS	58 %	21	49	28	28
Light Trucks and Vans	Infant	L/S	0 %	0	0	0	0
Light Trucks and Vans	Infant	None	0 %	12	12	0	7
Light Trucks and Vans	Toddler	CSS	59 %	42	103	61	61
Light Trucks and Vans	Toddler	L/S	48 %	15	29	14	17
Light Trucks and Vans	Toddler	None	0 %	63	63	0	37

Note: *Potential Fatalities* may not equal sum of *Fatalities* and *Lives Saved* due to independent rounding. Fatalities where restraint use was unknown have been prorated between the restraint use categories and included in this table.

Table 3, above, shows that infants and toddlers in child safety seats in passenger cars accounted for an estimated 309 lives saved in 2003. In light trucks and vans, an estimated 89 infants and toddlers had their lives saved due to being restrained in child safety seats. In 2003, lap and/or shoulder belts saved an estimated 45 lives

among toddlers in passenger cars or light trucks and vans. Overall, an estimated 443 infant and toddler lives were saved in 2003, an increase of 67 over the 376 lives saved during the year of 2002.

Table 4 Previous Methodology: Estimated Lives Saved Among Infants and Toddlers Through Child Safety Seat (CSS) or Lap and/or Shoulder Belt (L/S) Usage, FARS 2003							
Vehicle Type	Child's Age	Restraint Type	Effectiveness	Fatalities	Potential Fatalities	Lives Saved	Potential Lives Saved
Passenger Cars	Infant	CSS	69 %	51	166	114	114
Passenger Cars	Infant	L/S	36 %	0	0	0	0
Passenger Cars	Infant	None	0 %	34	34	0	23
Passenger Cars	Toddler	CSS	47 %	105	199	94	94
Passenger Cars	Toddler	L/S	36 %	35	54	20	26
Passenger Cars	Toddler	None	0 %	93	93	0	44
Light Trucks and Vans	Infant	CSS	69 %	11	37	25	25
Light Trucks and Vans	Infant	L/S	36 %	0	0	0	0
Light Trucks and Vans	Infant	None	0 %	22	22	0	15
Light Trucks and Vans	Toddler	CSS	47 %	32	59	28	28
Light Trucks and Vans	Toddler	L/S	36 %	15	24	9	11
Light Trucks and Vans	Toddler	None	0 %	73	73	0	34

Note: *Potential Fatalities* may not equal sum of *Fatalities* and *Lives Saved* due to independent rounding. Fatalities where restraint use was unknown have been prorated between the restraint use categories and included in this table.

The change in lives saved methodology for infants and toddlers is displayed by comparing Table 3 (New Methodology) and Table 4 (Previous Methodology). Table 3 is produced using the current effectiveness numbers, while Table 4 is produced with the effectiveness numbers that were used prior to 2002. These two tables both provide estimates of lives saved in 2003.

For all four combinations of vehicle type and age group, the new fatality counts for children in child safety seats climbed an amount equal to the corresponding decline in fatalities among unrestrained children. This transfer of fatalities from one restraint use category to another was due to the shift of the “child safety seat used improperly” restraint category from “unrestrained” to “child safety seat.”

This shift, when combined with the new effectiveness estimates, led to a large increase in the lives saved estimates involving the use of child safety seats. For example, among toddlers in passenger cars, the number of child safety seat fatalities in 2003 would have been 105 using the old methodology, yet rose to 126 with the new methodology. The corresponding lives saved estimation for this category would have been 94

with the old methodology, and was 147 with the new methodology.

Lap/shoulder belt effectiveness estimates among toddlers rose 11 percentage points for passenger cars (from 36 percent to 47 percent) and 12 percentage points for LTVs (from 36 percent to 48 percent). This rise in effectiveness caused the estimated number of toddler lives saved by a lap and/or shoulder belt to increase from 20 to 31 among passenger cars, and from 9 to 14 among LTVs. For infants, lap and/or shoulder belt effectiveness dropped from 36 percent to zero percent. This drop in effectiveness did not change the number of lives saved for 2003, as no infants in lap and/or shoulder belts were fatally injured in 2003.

For both the old methodology and the new methodology, the estimated lives saved counts for unrestrained children remained at zero for each combination of vehicle type and age group.

The increase in lives saved by child safety seats and lap and/or shoulder belts caused the overall number of estimated lives saved for infants and toddlers in 2003 to increase substantially to 443 lives saved. Using the old methodology (Table 4), the number of estimated lives saved in 2003 would have been limited to 289.

REFERENCES

Hertz, Ellen. *Revised Estimates of Child Restraint Effectiveness*, NHTSA Research Note, December 1996.

Partyka, Susan. *Lives Saved by Child Restraints from 1982 through 1987*, DOT HS 807 371, December 1988.

For additional copies of this research note, please call 1-800-934-8517 or fax your request to (202) 366-3189. For questions regarding the data reported in this research, contact Marc Starnes [202-366-0183]. This research note and other general information on highway traffic safety may be accessed by internet users at: <http://www-nrd.nhtsa.dot.gov/departments/nrd-30/ncsa/AvailInf.html>

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